

## **CRUISE RESULTS**

**Cruise 1999-01 Arcturus**  
**Cruise 1999-01 Aldebaran**

### **1999 Eastern Bering Sea Crab and Groundfish Survey**

**May-July 1999**

The Resource Assessment and Conservation Engineering (RACE) Division of the Alaska Fisheries Science Center (AFSC) conducted the annual crab and groundfish bottom trawl survey of the eastern Bering Sea shelf from May to July 1999. This was a continuation of the annual series of eastern Bering Sea crab-groundfish assessment surveys which began in 1971.

## **OBJECTIVES**

The primary objective of this survey was to continue the annual series of assessment surveys of crab and groundfish of the eastern Bering Sea to provide information for:

1. the North Pacific Fishery Management Council on the distribution, abundance, and biological condition of important groundfish and crab species;
2. the U.S. fishing industry on catch per unit effort and size composition, and;
3. the support of ongoing studies on the biology, behavior, and dynamics of key ecosystem components.

Secondary objectives were to:

1. conduct additional sampling in areas of high king crab and Tanner crab abundance to reduce variability in population estimates;

2. evaluate bottom trawl performance and configuration with net mensuration equipment;
3. collect and preserve specimens of fish and invertebrates for a voucher data base;
4. collect additional biological information including age and growth, sex ratio, feeding ecology/morphology, and habit preference from rex sole (*Errex zachirus*);
5. collect stomach samples for trophic interaction studies;
6. collect specimens of bigmouth sculpin (*Hemitripterus bolini*), egg masses, ovaries, and sponge to describe bigmouth sculpin development and life history;
7. collect and preserve various whole specimens and tissue samples from both fish and invertebrates for special study requests;

#### **VESSELS AND GEAR**

Sampling at the standard sites was coordinated between two chartered commercial vessels, the F/V Arcturus and F/V Aldebaran. Both vessels were 39.6 m (130 ft) in length.

The bottom trawl used at all standard sampling stations was an 83-112 eastern trawl. These nets have a 25.3 m (83 ft) headrope and a 34.1 m (112 ft) footrope (Fig. 1). They were towed behind 1,000 kg, 1.8 X 2.7 m, steel V-doors and 54.9 m (180.1 ft) paired dandyline. Each lower dandyline had a 0.61 m chain extension connected to the lower wing edge to improve bottom tending characteristics. The 83-112 eastern trawl has been the standard sampling net used during annual eastern Bering Sea surveys since 1982 when it replaced the 400 mesh eastern trawl, previously used since the 1970s.

Seawater temperature profiles were collected at most sampling sites using a micro-bathythermograph attached to the headrope of the net. Surface seawater temperatures were also collected with a bucket thermometer.

Net mensuration systems and bottom contact sensors aboard both vessels were used to provide sampling net configuration and performance data to be used in area-swept and catch-per-unit-effort (CPUE) calculations.

## ITINERARY

The Arcturus and Aldebaran began the survey in Dutch Harbor, Alaska on May 19. Both vessels returned to Dutch Harbor on July 24 upon the completion of the 1999 eastern Bering Sea crab-groundfish survey. Intervening port calls were made by both vessels in Dutch Harbor on June 9, and July 1 to obtain supplies and/or exchange scientific personnel.

## SURVEY DESIGN AND METHODS

The standard survey area is shown in Figure 2. Sampling sites were established on the basis of a 20 x 20 nm grid pattern used during previous surveys, although more intensive sampling was carried out in the Pribilof Islands and St. Matthew Island regions to collect additional data on crab populations. Additional stations northwest of the standard survey area were established to estimate the abundance of Tanner crab (*Chionoecetes opilio*) in that area.

The Arcturus and Aldebaran then sampled alternate north/south columns of stations proceeding from Bristol Bay westward to the shelf edge. Tows of 30 minutes in duration were made at most sampling sites. All catches were sorted to the lowest possible taxon, weighed, and enumerated. Station data including time, position, trawl performance, distance fished as well as catch information were entered onto diskettes with shipboard computer systems. Age samples (by sex-centimeter category), size composition, and other biological data were collected from the major fish species encountered. Length-width measurements, shell condition, clutch size, and tissues and organs for various studies were collected from the major crab species. Special study collections were stored in appropriate fixatives or were frozen.

## RESULTS

The Arcturus and Aldebaran conducted 380 standard bottom trawls during the survey including 373 successfully completed trawls at scheduled sampling sites and 7 unsuccessful hauls. Two standard stations in inner Bristol Bay could not be sampled due to extensive ice coverage.

Upon completion of the standard survey, the Arcturus sampled 12 deep water tows (> 200 m) to assess the abundance and distribution of *opilio* Tanner crab on the continental slope. The Arcturus

then proceeded to Pavlov Bay to conduct the annual forage species/shrimp survey. While the Arcturus conducted this study, the Aldebaran re-sampled 34 stations in Bristol bay to collect additional information on red king crab.

Biological data collected from fish species are summarized in Table 1. The two vessels recorded 165,129 length measurements from the major fish species and 5,129 age structures were collected and preserved. Individual length-weight data were also recorded during the otolith collection process. A total of 9,511 stomachs were preserved from various fish taxa for feeding habit analysis.

Whole specimens and tissue samples of various fish and invertebrate species were preserved for identification, training, and other purposes.

The total standard survey area encompassed approximately 463,400 km<sup>2</sup>. Catch rates of important fish and crab species, by depth zone, are shown in Table 2.

Walleye pollock (*Theragra chalcogramma*) was the most abundant round-fish species and had an overall CPUE of 76.0 kg/ha trawled. They were encountered at nearly all sampling sites, with largest mean catches (184.2 kg/ha) observed in outer shelf waters at depths of 100-200 m (Fig. 3). Mean catches were much lower at depths less than 50 m (11.5 kg/ha).

Rock sole (*Lepidopsetta bilineata*) and yellowfin sole (*Limanda aspera*) were the most abundant flatfish species, with overall CPUE values of 35.2 kg/ha and 26.3 kg/ha, respectively. Yellowfin sole were primarily restricted to the central and inner shelf waters, while rock sole were more broadly distributed with concentrations in Bristol Bay, around the Pribilof Islands, and the outer shelf (Figs. 4 and 5). Yellowfin sole catches decreased sharply with increased depth, from 70.3 kg/ha in waters less than 50 m to less than 1.0 kg/ha in waters greater than 100 m (Table 2). A similar depth-related decrease in rock sole abundance was also observed.

Pacific cod (*Gadus macrocephalus*) were encountered at most of the sites sampled (Fig. 6). Mean catch rates were smallest at inner shelf stations less than 50 m (2.7 kg/ha) and greatest in the central shelf region (18.7 kg/ha).

Alaska plaice (*Pleuronectes quadrituberculatus*), flathead sole/Bering flounder (*Hippoglossoides elassodon* and *H. robustus*), arrowtooth/Kamchatka flounder (*Atherestes stomias* and *A.*

evermanni), and Pacific halibut (*Hippoglossus stenolepis*) had a combined catch rate of 26.7 kg/ha. Alaska plaice and flathead sole/Bering flounder were the most abundant species of this group, with an overall catch rate of 11.1 kg/ha and 8.1 kg/ha respectively.

Opilio Tanner crab was the most abundant commercially important crab species encountered, with a total average catch rate of 2.9 kg/ha. Red king crab (*Paralithoides camtschatica*) had an overall mean CPUE of 1.7 kg/ha while blue king crab (*P. platypus*) and Bairdi Tanner crab (*C. bairdi*) each had overall catch rates less than 0.6 kg/ha trawled.

**SCIENTIFIC PERSONNEL<sup>a</sup>**ArcturusLeg 1

J. Hoff<sup>b</sup>  
 B. McConnaughey  
 G. Stauffer  
 G. Lang  
 S. Kotwiki<sup>c</sup>  
 R. MacIntosh<sup>d</sup>

Leg 2

G. Walters<sup>b</sup>  
 D. Nebenzahl  
 K. Smith  
 S. Kotwiki  
 P. Cummiskey<sup>d</sup>  
 S. Loy<sup>d</sup>

Leg 3

P. Anderson<sup>bd</sup>  
 G. Mundell  
 D. Benjamin  
 S. Kotwiki  
 M. Nelson  
 B. O'Gorman<sup>d</sup>

AldebaranLeg 1

C. Armistead<sup>bd</sup>  
 D. Nichol  
 D. Nebenzahl  
 F. Morado  
 G. Tyler  
 J. Hagga<sup>d</sup>

Leg 2

D. Nichol<sup>b</sup>  
 J. Hoff  
 T. Buckley  
 L. Appesland  
 B. Stevens<sup>d</sup>  
 G. Harrington<sup>d</sup>

Leg 3

T. Sample<sup>b</sup>  
 E. Acuna  
 D. Powell<sup>e</sup>  
 M. Yang  
 E. Munk<sup>d</sup>  
 K. Smith

<sup>a</sup> Personnel from the AFSC, Seattle, unless otherwise noted

<sup>b</sup> Field Party Chief

<sup>c</sup> Personnel from the International Pacific Halibut Commission

<sup>d</sup> Personnel from the AFSC, Kodiak Laboratory

<sup>e</sup> Personnel from University of Maryland

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Table 1.--Biological data collected during the during the 1999 eastern Bering Sea crab-groundfish survey.

Species	Length measurements	Age structures <sup>1/2/</sup>	Stomach samples
Walleye pollock	37,452	1,385	2,855
Pacific cod	11,699	878	2,243
Yellowfin sole	31,308	777	1,028
Rock sole	37,423	514	799
Flathead sole/ Bering flounder <sup>3/</sup>	17,690	420	603
Pacific halibut	1,655	--	439
Alaska plaice	13,494	297	478
Arrowtooth flounder/ Kamchatka flounder <sup>4/</sup>	8,141	--	331
Greenland turbot	207	11	67
Rex sole	830	358	--
Longhead dab	2,584	489	--
Misc. sculpins	276	--	276
Starry flounder	677	--	--
Misc. skates	392	--	392
Pacific herring	842	--	--
Pacific Ocean perch	160	--	--
Misc. species	299	--	--
Total	165,129	5,129	9,511

<sup>1/</sup> Scale scrape samples, in addition to otoliths, were collected from Pacific cod. Only otoliths were taken from all other species.

<sup>2/</sup> Individual length-weight data were also collected from Pacific cod.

<sup>3/</sup> Age structures were collected from flathead sole only.

<sup>4/</sup> Age structures were collected from each species separately.

Table 2.--Catch rates (kg/ha) by depth zone of commercially important fish and crab species taken aboard the Arcturus and Aldebaran during the 1999 eastern Bering Sea crab-groundfish survey.

Species	Inner shelf < 50 m	Central shelf 50-100 m	Outer shelf 100-200 m	Total area
Walleye pollock	11.5	51.8	184.2	76.0
Yellowfin sole	70.3	21.1	0.1	26.3
Rock sole	51.2	44.0	7.0	35.2
Pacific cod	2.7	18.7	12.7	13.4
Alaska plaice	18.9	13.3	2.0	11.1
Flathead sole/ Bering flounder	0.8	8.6	14.6	8.1
Arrowtooth flounder/ Kamchatka flounder	<0.1	2.7	14.3	4.8
Pacific halibut	1.4	3.0	3.7	2.7
Opilio Tanner crab	0.5	3.1	4.1	2.9
Red king crab	1.5	2.9	0.0	1.7
Bairdi Tanner crab	0.1	0.9	0.5	0.5
Blue king crab	<0.1	0.5	<0.1	0.2

## 83/112 EASTERN

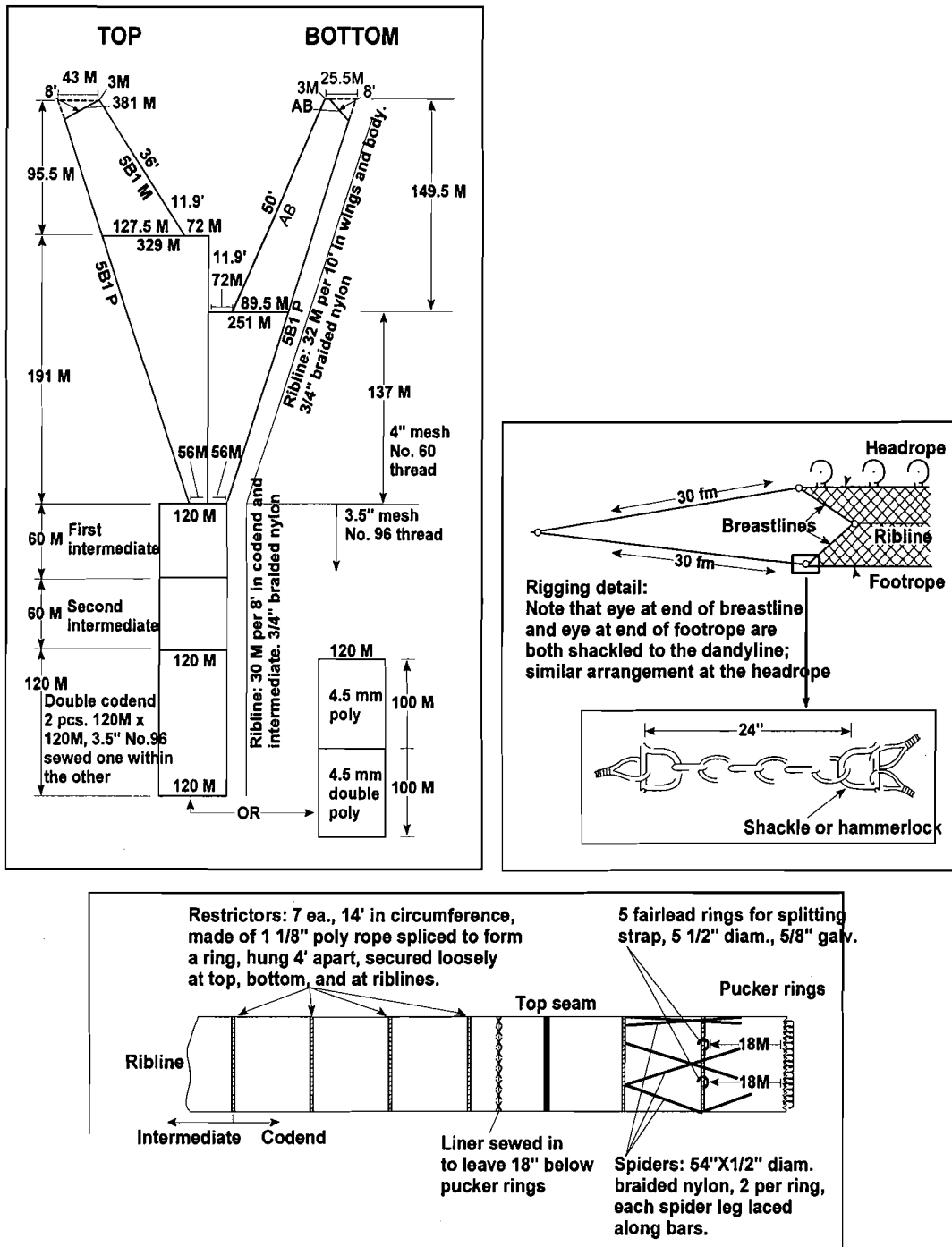


Figure 1.--Diagram of the 83-112 eastern bottom trawl used in the 1999 eastern Bering Sea groundfish survey.

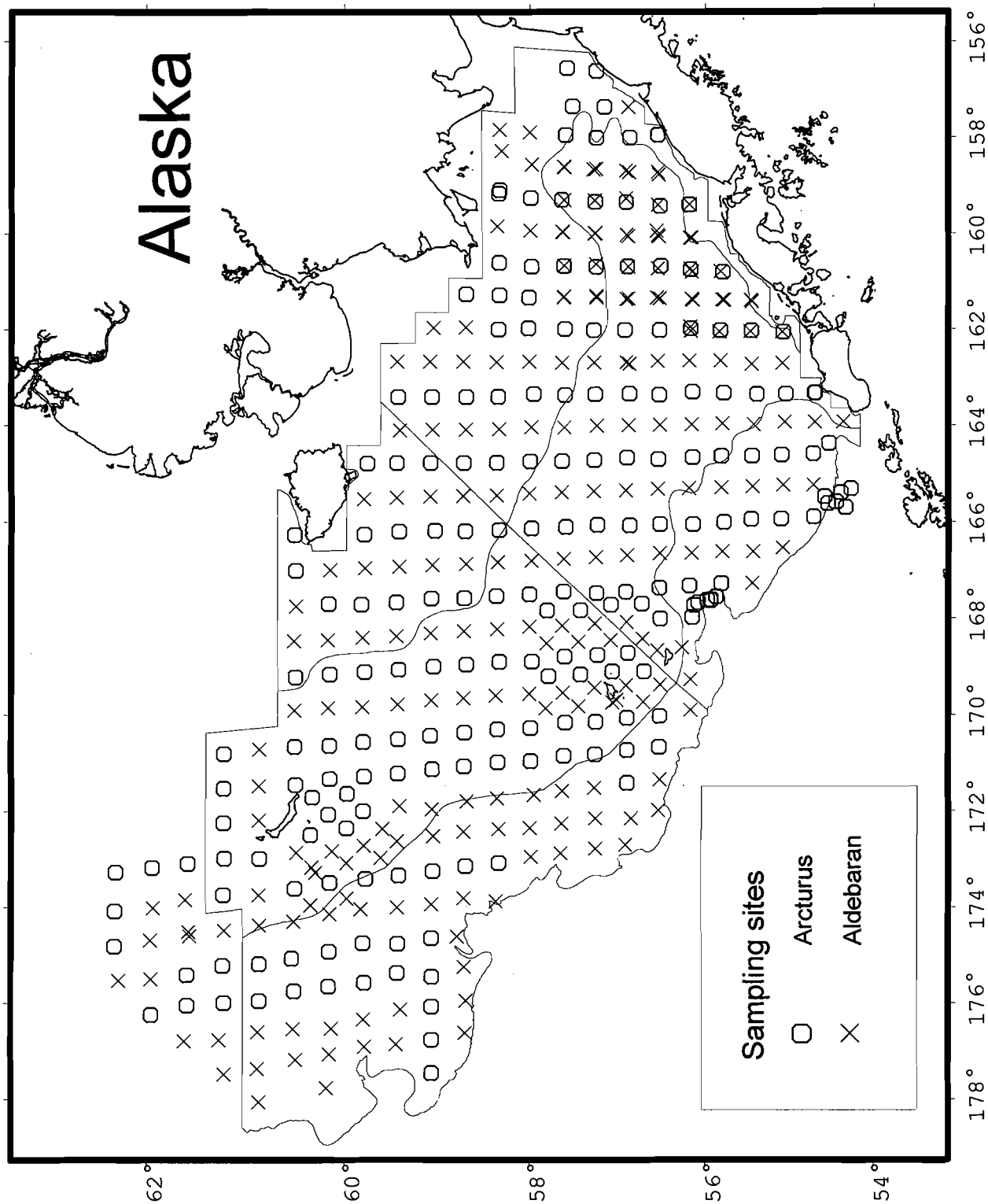


Figure 2.--Distribution of total sampling effort by the Aldebaran and Arcturus during the 1999 eastern Bering Sea bottom trawl survey.

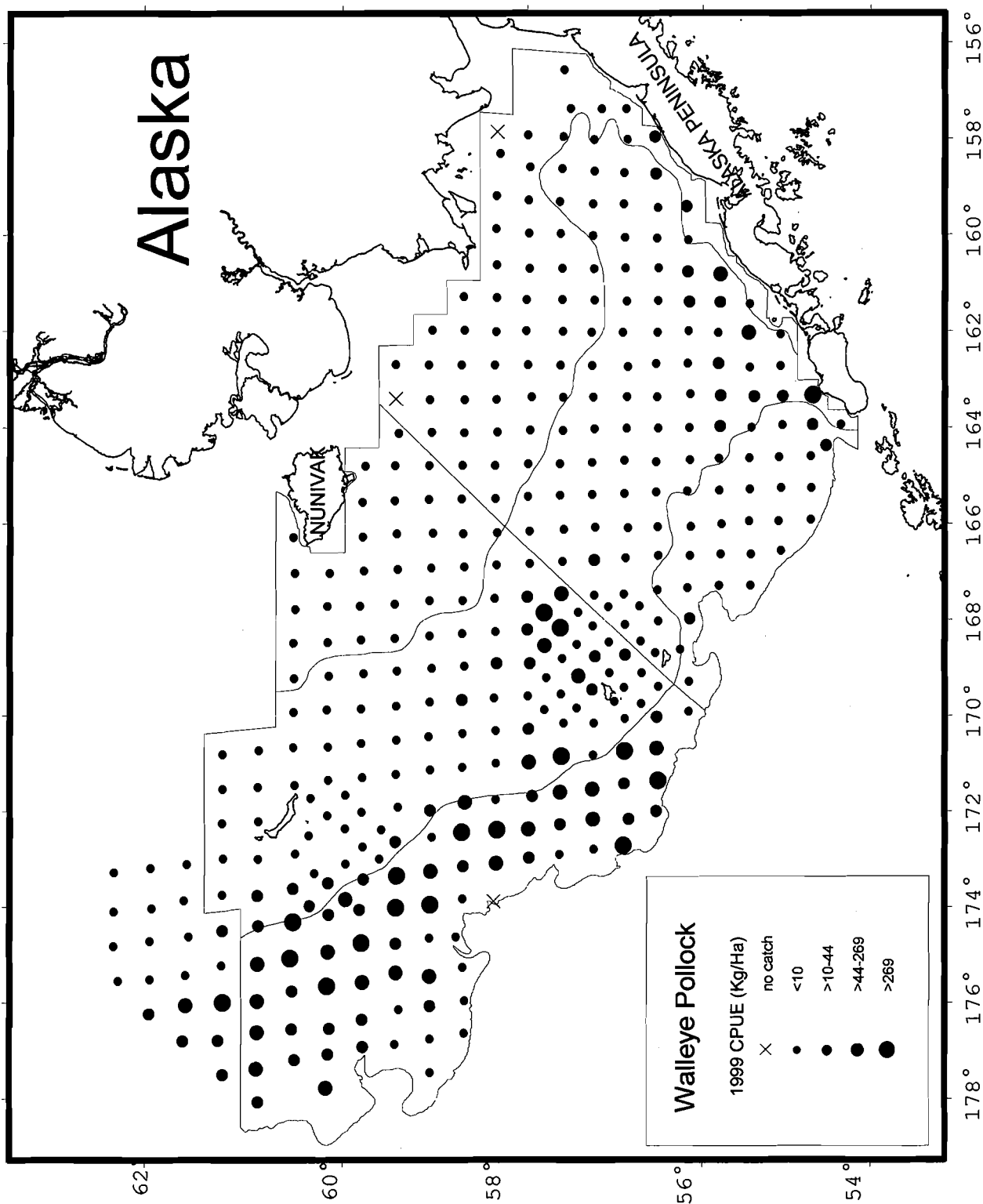


Figure 3.--Distribution and relative abundance of walleye pollock during the 1999 eastern Bering Sea bottom trawl survey.

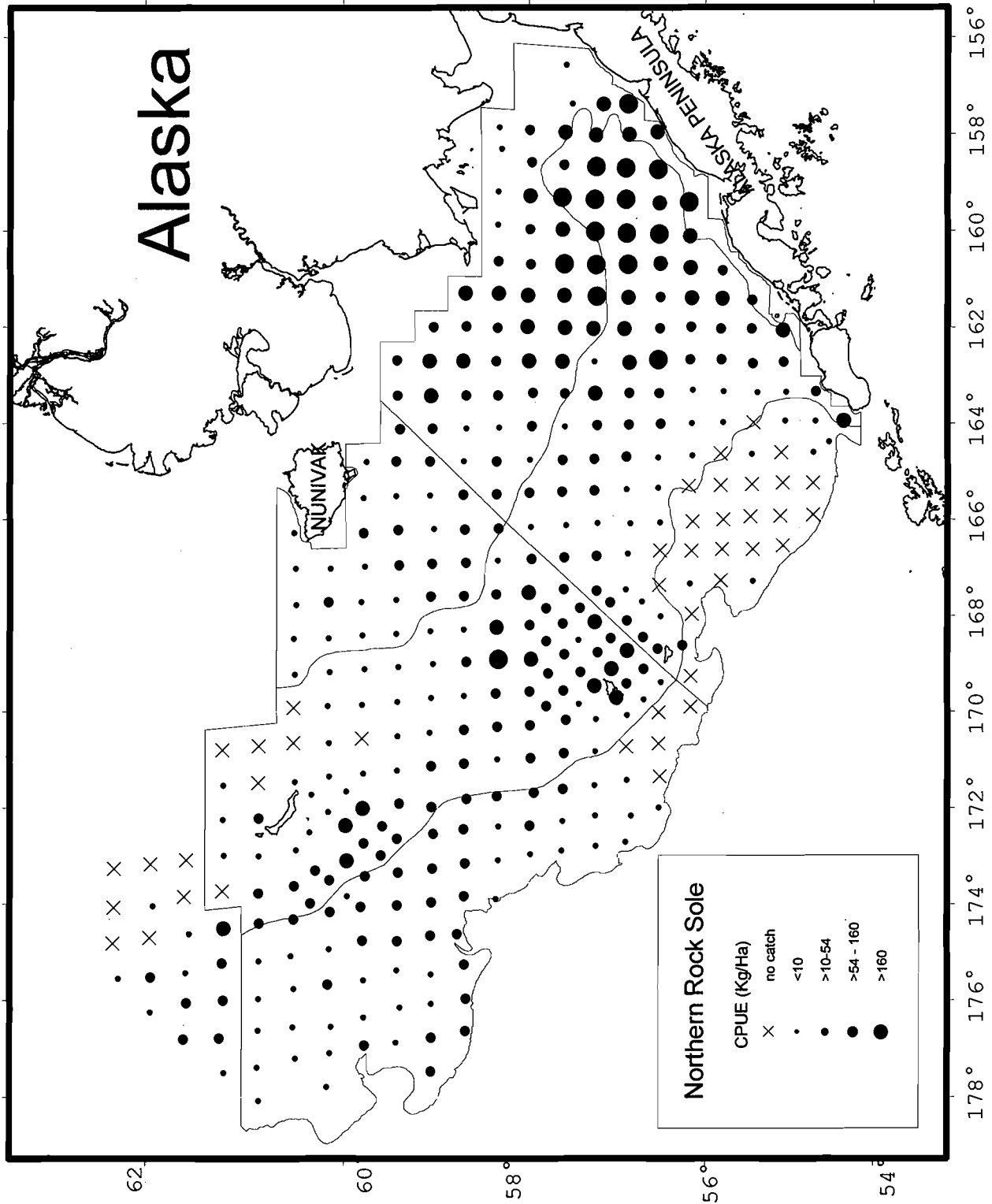


Figure 4.--Distribution and relative abundance of northern rocksole during the 1999 eastern Bering Sea bottom trawl survey.

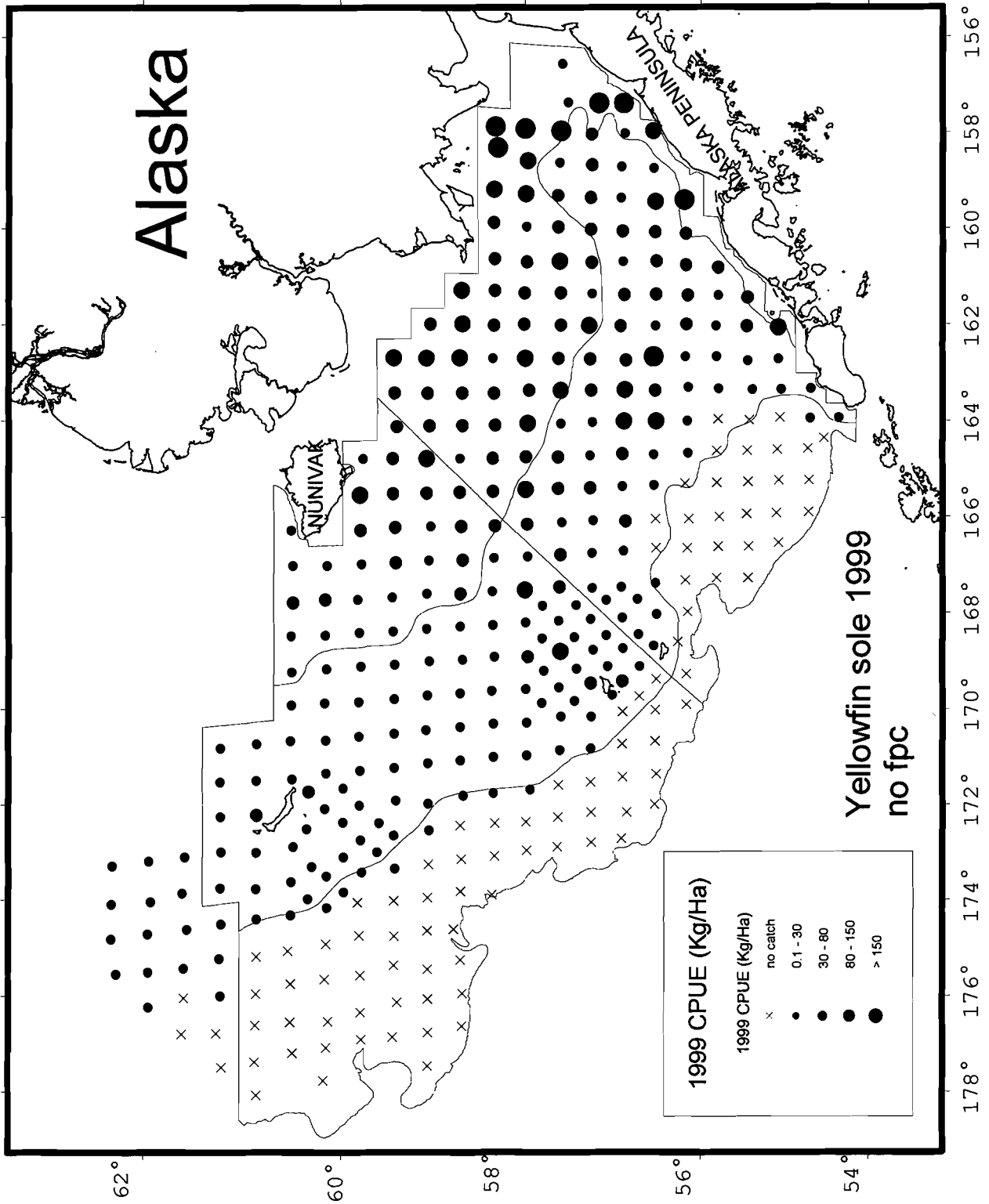


Figure 5.--Distribution and relative abundance of yellowfin sole during the 1999 eastern Bering Sea bottom trawl survey.

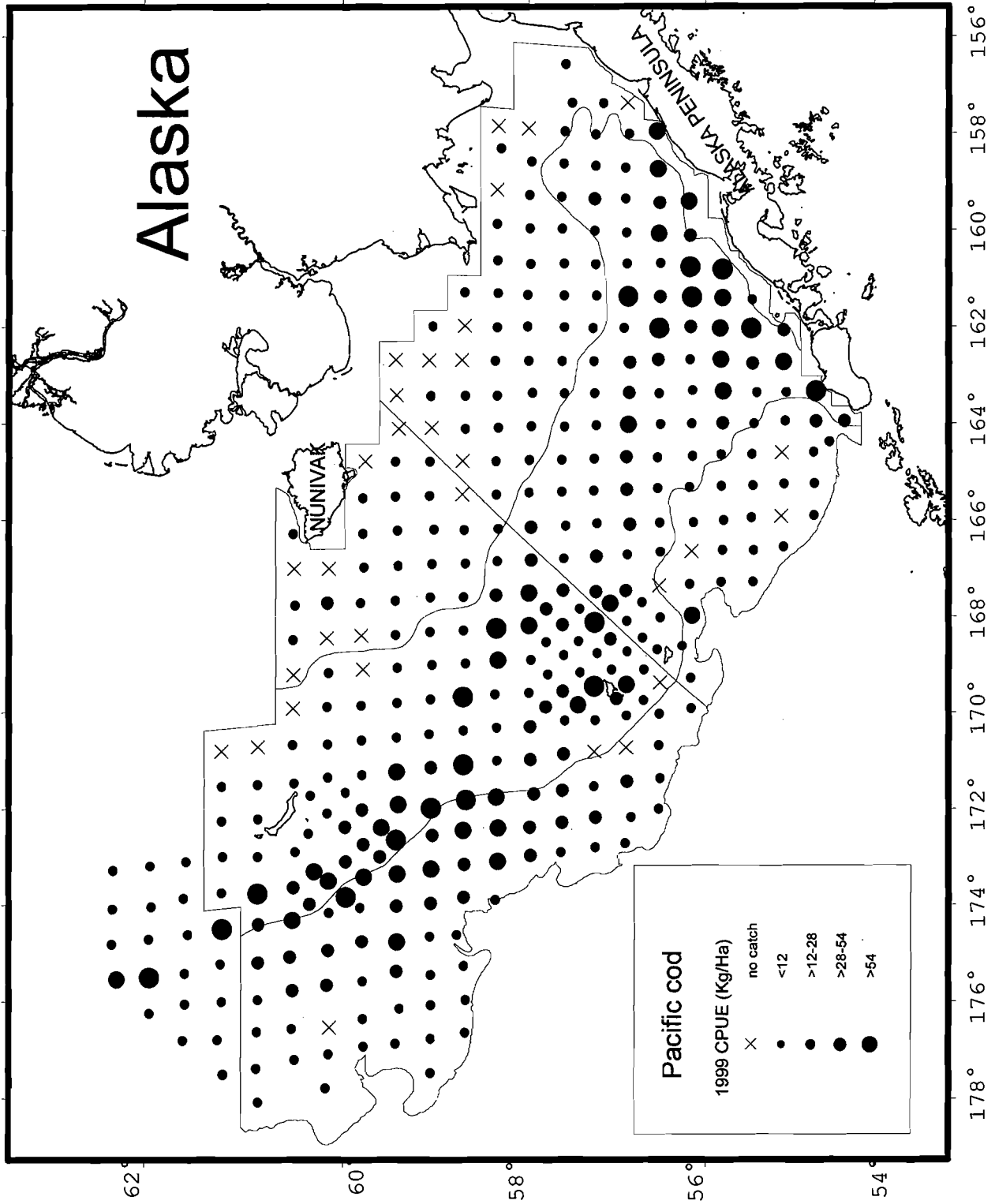


Figure 6.--Distribution and relative abundance of Pacific cod during the 1999 eastern Bering Sea bottom trawl survey.